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No. 220

AMERICAN BEECH

American beech is one of the "big three" (beech, birch, maple) of northern hardwoods. Though low in decay resistance, most beech sapwood and "white" heartwood can be treated easily with wood preservatives. The wood is hard, strong, machines well, and has no characteristic taste or odor. Though formerly much used for railway ties, the species is now used principally for boxes, crates, baskets, pallets, furniture parts, and flooring. Because its physical and mechanical properties are so balanced, it is highly rated for nearly all wood-machining processes, making the wood suitable for many special uses such as food containers, woodenware, and novelties.

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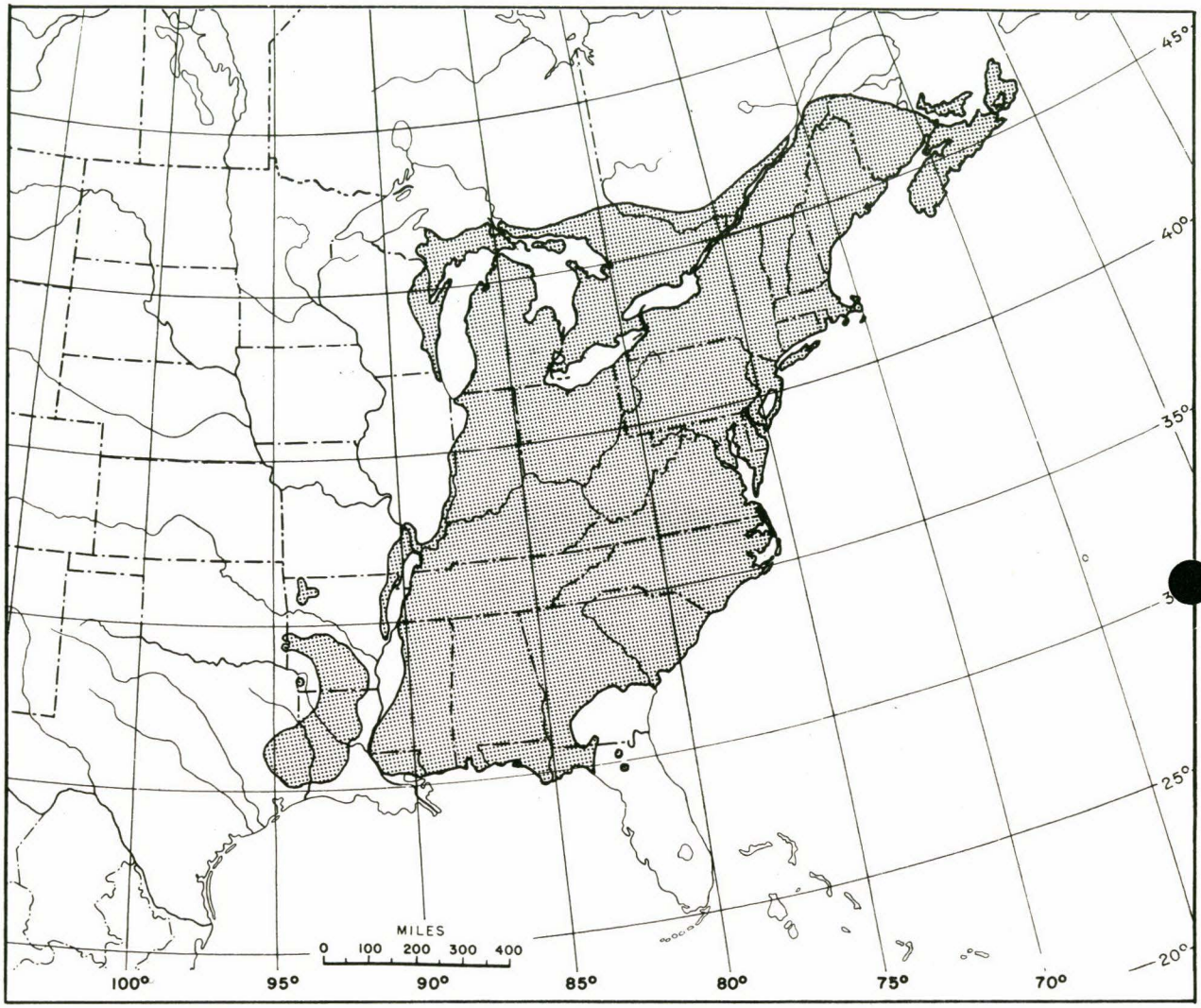

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Figure 1.—The range of American Beech.

AMERICAN BEECH

(Fagus grandifolia)

Roswell D. Carpenter [1]

DISTRIBUTION

Beech grows in the southeastern provinces of Canada and in the eastern half of the United States, where its range extends southward from Maine to northern Florida and westward from the Atlantic Coast to Wisconsin, Missouri, and east Texas (fig. 1). Except for some Mexican distribution, beech is now confined to the Eastern United States and southeastern Canada, though it once extended as far west as California and probably flourished over most of North America before the glacial period.

Beech usually grows in mixture with other species, although some fairly large pure stands occur in the Appalachian Mountains, especially in North Carolina. Some of its principal associates are sugar maple, yellow birch, American basswood, black cherry, eastern hemlock, eastern white pine, red spruce, sweetgum, southern magnolia, the ashes, several hickories, and oaks. Beech is listed in 16 cover types recognized by The Society of American Foresters, and is named as an important component of four.

Beech grows best on deep, rich, well-drained, moist soils, and on theose of a loamy texture; soils with a high humus content are more favorable than lighter ones. The largest trees are found in the alluvial bottom lands of the Ohio, Missouri and Red Rivers and along the western slopes of the Appalachians.

DESCRIPTION AND GROWTH

Mature beech trees are generally 80 to 120 feet tall and 18 to 50 inches in diameter (at breast height). Individual trees over 4 feet in diameter and 120 feet tall have been recorded, but these trees frequently are hollow at the butt. Attaining such size takes 350 to 400 years. At present, the largest beech tree standing is 18 feet 5 inches in circumference at breast height and 91 feet high, and it has a 96-foot crown spread.

The root system of beech is well developed but tends to be shallow where soil moisture and air humidity are ample. Roots spread strongly in the humus layer and also grow fairly deep into the mineral soil. The species is comparatively windfirm, except possibly on shallow soils.

Beech is regarded as the most tolerant hardwood species in some parts of its range, but its tolerance is less on poor soils or in cold climates.

Beech trees prune themselves nicely in well-stocked stands. With good stocking on favorable sites, a substantial number of them have narrow, compact crowns with long, clean, straight boles. Open-grown trees develop short, thick trunks with large, low, spreading limbs terminating in slender, somewhat drooping branches, forming a broad, round-topped head.

Beeeh trees often develop *epicormic* branches (growing from dormant buds) when injured or suddenly exposed by cuttings in the stand, or following glaze damage or low temperature injury.

At about 40 years of age, beech trees begin to produce seed in the form of small nuts and yield good crops at 3, 4 or 5-year intervals. Rodents are chiefly responsible for seed distribution. Beech seedlings need warmth, shade, and humus for satisfactory growth, and are fairly hardy once they have gained a start.

Beech sprouts well from the stumps of young trees, but this capacity diminishes markedly after the trees reach 4 inches in diameter. Sprouts from stumps 10 to 15 inches in diameter are usually short-lived and rarely attain tree stature. Beech trees develop root suckers in large numbers, and many of these grow into pole-size timber, though few end up as merchantable forest trees.

Beech nuts are borne in an egg-shaped prickly husk, two or three to a husk. The edible nut is thin-shelled and shining chestnut-brown, ½ to ¾ inch long, and triangular in cross-section. The leaves are 2½ to 6 inches long; 1 to 2½ inches wide; elliptical to oblong ovate in shape; remotely serrate with sharp, incurved teeth along the margins; and shiny

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surfaces above and below. The bark is thin, smooth, light bluish-gray, often mottled, and does not change appreciably as the tree ages. (figs. 2 and 3).

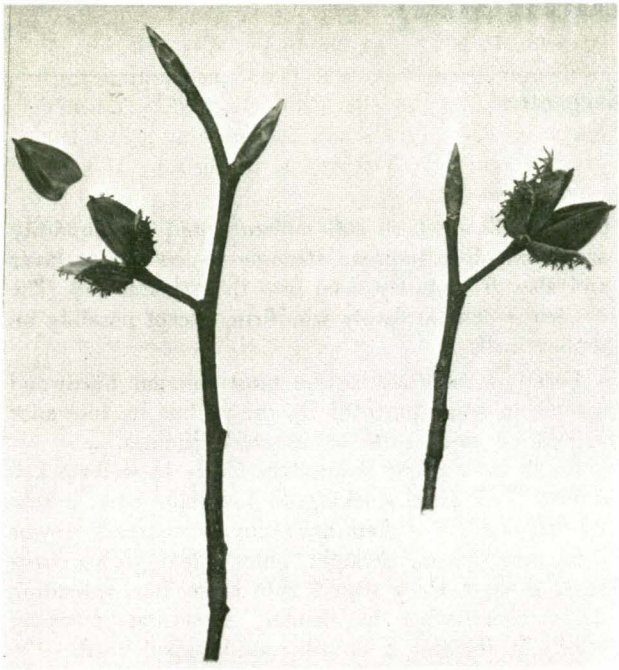

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Figure 2.—American Beech (*Fagus grandifolia*) bark. leaves, fruit.

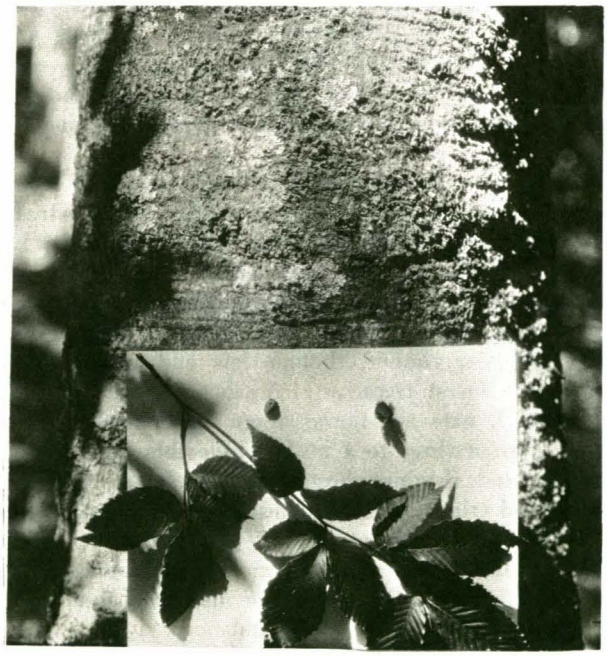

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Figure 3.—Fruit of the American Beech.

Thin bark and large surface roots make beech highly vulnerable to fire and sunscald. Repeated fires can virtually eliminate it.

The growth characteristics and the tolerances of beech help explain its reaction to different cutting practices. Clearcutting usually results in fewer trees in the new stand than in the old. Repeated clearcutting on short rotations, as was done in the acid wood industry, may cause beech to almost disappear because in the open its seedlings, sprouts, and suckers are outgrown by the reproduction of almost all associated species. Under light selection cuttings, the tolerance of beech enables it to increase in relative abundance. However, the high proportions of beech in many present stands result more from lack of management than from silvical characteristics—the beech was left when more valuable species were cut.

Beech endures widely varying climatic conditions, as evidenced by its range. Late spring frosts occasionally damage beech foliage. Low winter temperatures cause long frost cracks in the tree trunks. Extremely low temperatures can cause more serious harm under certain circumstances. Late spring frosts occasionally damage beech foliage. Low winter temperatures cause long frost cracks in the tree trunks. Extremely low temperatures can cause more serious harm under certain circumstances.

Beech is no more susceptible to breakage by gl storms than most of its associated hardwood species. However, it is highly susceptible to several wood-rotting fungi that find entrance through broken branch stubs and sunscald wounds. Wounds from artificial pruning, logging injuries, or storm damage heal comparatively slowly.

COMMON NAMES

Beech is the name commonly used. "American beech" is used to distinguish the tree from the European species. Trees with notably darker colored heartwood are called red beech in some localities, and those with lighter heartwood or much sapwood are called white beech.

RELATED COMMERCIAL SPECIES

American beech (*Fagus grandifolia*) is the sole representative of the genus Fagus on the North American continent. The existence of "races" in beech has been assumed occasionally, but without supporting evidence. These assumptions distinguish three races or "variants" of beech in the United States, plus fourth in the mountains of Mexico. The three U.S.

ces have been designated as gray, white, and red beeches; and the Mexican race is said to be very close to our gray beech. The three races overlap geographically.

In addition to the species type, one variety is recognized—Carolina beech (*Fagus grandifolia* var. *Caroliniana*) which is widely distributed in the Southern States, northward to New Jersey and Ohio, and ranges from bottomlands and swamp borders up to 4,000 feet elevation in the mountains. In the American market the mentioned races and variant are all sold as American beech.

Early estimates of the supply of beech were based mostly on reconnaissance-type observations and represent only part of the volume then actually standing. Since the initiation of the national forest survey, conducted by the Forest Service, reliable reports of the supply have been provided and are maintained periodically. These reports show that the supply was underestimated previously. Periodic State-by-State surveys demonstrate that the beech supply has been increasing mainly through the accumulation and growth of low-quality and small trees.

Estimates of beech sawtimber before the completion of the first forest survey in all of the States ranged from 4.1 billion to 8.5 billion board feet.

The survey showed that in 1952 there were 15.8 billion board feet of sawtimber-size beech trees in the eastern United States. Ten years later the volume had increased to 19.3 billion board feet. In addition, the forest survey reported about 43 million cords of smaller beech in 1962.

Almost 56 percent of the beech timber resource grows in the 12 New England and Mid-Atlantic States. The four leading States, respectively, are New York, Kentucky, West Virginia, and Pennsylvania—supporting almost 51 percent of the volume. Vermont, Michigan, and Maine follow closely in that order. Beech sawtimber now constitutes about 4 percent of all the hardwood sawtimber in the United States.

PRODUCTION

Beech timber is cut into factory lumber logs, veneer logs and bolts, railway tie logs, cooperage bolts, chemical wood (for charcoal and distillates), and pulpwood.

By far the greatest proportion is cut for conversion into lumber. The production of beech lumber was first recorded and reported separately in 1905 when a total of 219 million board feet was sawed in 20 states—with Michigan, Indiana, New York, and Ohio contributing over 80 percent of the cut.

By 1909, this total had risen to about 511.2 million board feet—the all-time high. After 1909, production declined, reaching 42.3 million board feet in 1932—the all-time low. Pennsylvania led in production every year from 1924 to 1939 except for 1931.

By 1942, production had recovered to almost 317.4 million board feet, cut in 29 states, the largest since 1919 and doubtless due to demands created by World War II. The five leading States in beech lumber production in 1942 were Kentucky, West Virginia, Pennsylvania, Tennessee, and Ohio—accounting for over 60 percent of the cut. Production then continued at between 300 million and 360 million board feet annually until 1952, when it dropped to 100 million board feet.

From 1952 through 1965, beech lumber production ranged between 166 million and 252 million board feet. New York, Kentucky, West Virginia, Pennsylvania, Michigan, Ohio, Indiana, Maine and Vermont continued to produce substantial volumes of beech lumber.

Only about 5 percent as much beech timber is cut for veneer logs as for lumber production, and it comes from the highest quality beech trees. The volume cut for veneer between 1924 and 1929 varied from 4.7 million board feet, log scale to nearly 17.4 million board feet, log scale. The average annual consumption of beech veneer logs in 1929, 1931, 1935, and 1937 was 12.3 million board feet, log scale. More recently, the annual volume has leveled off at about 10 million board feet, log scale, the 1963 production being 10.1 million board feet. Maine produced 52 percent of this volume.

Natural enemies of beech include the beech scale, several wood-rotting fungi, and the saddled prominent (caterpillar).

Beech scale followed by Nectria species produces the bark disease that causes extensive mortality in parts of New York, New England, and adjacent Canada, killing as much as 50 percent of the trees in some localities. Wood-rotting fungi cause considerable losses in volume and value of beech wood.

The most serious beech defoliator is the saddled prominent. Other insects that may cause severe damage are the gypsy moth and Bruce's spanworm.

CHARACTERISTICS AND PROPERTIES

Beech is one of our heavy native hardwoods: it has an average weight of 45 pounds per cubic foot, and specific gravity of 0.56, and rates high on the hardness scale. It shrinks substantially during seasoning and requires maximum care to avoid checks, warping, and discoloration. Beech rates high in strength, shock resistance, and stiffness, yet bends readily when steamed. Because its physical and mechanical properties are so balanced, it rates high among native hardwood species for nearly all wood-machining processes. These and other properties make

the wood suitable for a number of special uses: food containers, furniture parts, turned good, and many articles classified as woodenware and novelties. Beech gives an average yield of 32 percent of dense high-quality charcoal and is favored as fireplace wood.

The wood is fairly uniform in texture, dark to light reddish brown, without pronounced figure. The heartwood varies from reddish brown to nearly white with a reddish tinge; the sapwood is also nearly white tinged with red, and generally 2 to 5 inches wide on mature trees. Often sapwood cannot be distinguished from heartwood. The annual rings, although not conspicuous, are distinct. The pores in each annual ring decrease in size and number as seasonal growth progresses, giving a darker appearance to that part of the ring grown late in the season.

Beech ranks high in nail-holding ability but has a tendency to split in nailing. It is difficult to work with hand tools. The wood wears well and stays smooth when subjected to friction even under water. This wearing ability has contributed to its wide use for many years as factory flooring—particularly in machine shops and textile mills where hand and lift trucks are used.

After it has been steamed, beech wood can be bent readily and held in clamps while drying to set desired curvature permanently. Its ability to maintain curvature after bending has led to increasing use for curved chair parts.

Beech wood is *not* resistant to decay. In this respect, it ranks with birch, maple, and red oak—below sweetgum heartwood and southern pine, but well above basswood, cottonwood, and sap sweetgum. When treated by the pressure process, the sapwood and "white" heartwood are readily penetrated with a wood preservative like creosote. "Red" heartwood is difficult to penetrate with preservatives, and retention is uncertain. Beech can be glued successfully, but close control of the gluing conditions is required. Beech wood is finished readily with either paint or transparent finishes.

Beech was formerly considered comparatively difficult to manufacture into paper pulp and was pulped almost entirely by the soda process. Now it is easily converted into useful pulps by most currently used processes. However, because of some natural characteristics of the wood, beech pulps are not classified as high-quality, though they can be used well in mixture with other pulps. The short, fine fibers serve as a filler to produce the smooth surface and softness required in several papers. Beech can also be used as a partial replacement from coniferous woods in the manufacture of the viscose grade of dissolving pulp.

The chemical properties of beech make it an important source of several widely used chemicals. It is an outstanding wood for the production of methanol, acetate, and wood tar. Creosote made from beech wood tar is considered the best for medical purposes.

PRINCIPAL USES

Beech is used mainly for lumber, veneer, charcoal, railroad ties, and pulpwood. For many years, distillation and slack cooperage constituted two other important uses, but, with the substantial decrease in the demand for these products since World War II, the use of beech for such purposes has dwindled. In 1960, of 72,000,000 board feet of all native hardwoods used in the manufacture of both tight and slack cooperage, it is estimated that only about 100,000 feet was beech.

Beech lumber is remanufactured mainly into boxes, crates, baskets, and pallets; furniture (particularly chairs); flooring, sash, doors, trim, paneling, and general millwork; woodenware and novelties; and handles, brooms, and brushes. It is especially suitable for food containers because it imparts neither taste nor odor. Its excellent turning properties have contributed to its growing use for small articles made with a lathe.

The strength and hardness of beech, and its ability to take preservative treatment (with cresote or some other chemical) account for its suitability and use for railroad ties. Beech production for railroad ties (last reported in 1947) was 8000 ties.

In 1964, about 1 percent of mixed hardwood railroad ties produced for preservative treatment was beech. About 1,450,000 board feet, log scale, are required for this production.

Some beech is still used for the production of methanol, acetate, and wood tar; and increasing volumes are being used for charcoal since the revival of this industry in the late 1950's.

It is estimated that about 10 hardwood distillation plants remained in operation after 1961. There are no statistics available to estimate the volume of beech that may be used annually for distillation.

A revival of the use of charcoal, starting in the late 1950's and continuing currently, has paralleled the recent expansion in outdoor recreation and cooking. In 1961, about 250,000 tons of charcoal produced were estimated to be from hardwood. If 20 percent of this was beech, the annual consumption of beech for charcoal is currently 105,000 cords.

Increasing volumes of beech are being made into paper pulp, and this pulp is mixed with long-fibered wood pulps and used in the manufacture of paper for books and other papers that require a smooth surface and softness.

The use of a beech, birch, and maple for pulpwood is currently increasing at a rate of 2 percent per year and beech accounts for the major part of the increase.

It is estimated that 3750,000 cords of beech pulpwood e cut annually.

Beechnuts are sometimes gathered and sold. The nuts are sweet and somewhat oily and are a preferred food of some game animals and birds. Beech "mast" (nuts) was a favorite food for hogs that formerly ranged in large numbers in hardwood timber stands in the Appalachian Mountains and in the hardwood creek bottoms scattered throughout the southern piney woods.

Beech has always been favored for fuelwood; but, since wood has been replaced by coal, oil, and gas for use as fuel, beech is used mainly for fireplace wood. Only hickory and white oak rate above it in heating value.

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